# 'Lisbon' Lemon Selection Trials in Arizona – 2007-08[1]

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***Abstract***

*Four 'Lisbon' lemon selections, 'Frost Nucellar', 'Corona Foothills', 'Limoneira 8A' and 'Prior' were selected for evaluation on Citrus volkameriana rootstock. Yield was adequate for 2007-08, and suggests that 'Limoneira 8A Lisbon' and 'Corona Foothills Lisbon' are superior to the other two selections tested.*

## Introduction

There is no disputing the importance of citrus scion cultivar selections to desert citrus production. A successful citrus selection must be adaptable to the harsh climate, must be vigorous and must produce high yields of good quality fruit.

Lemons are the most important citrus grown in Arizona today. Today, lemons comprise 70% of all harvested citrus acreage in the state. When the Arizona lemon industry was established in the 1950's the principal variety was the 'Desert Lisbon'. No records exist as to the characteristics of this variety. Within a few years however, 'Desert Lisbon' was eclipsed in popularity by 'Frost Nucellar Lisbon' the only nucellar clonal selection of the 'Lisbon' variety. Other popular selections of 'Lisbon' that have been planted in Arizona include 'Monroe', 'Limoneira 8A', 'Prior', and 'Rosenberger'. Popular lemons common to Arizona that are not 'Lisbon' include 'Allen Eureka' and 'Corona Foothills' (also known as Foothills), a selection of 'Villafranca'. All of these represent selections of outstanding trees that were then propagated. All are identified by their originator or place of origin, and are characterized by high vigor, high productivity, precocity (trees bear at an early age), earliness (a high percentage of the fruit can be harvested before 15 November), short thorns and good fruit quality. However, there is a certain amount of variability among lemon clonal selections.

As the Arizona lemon industry has found itself a marketing niche for the late summer and fall harvest, tree qualities such as high productivity, good fruit quality and early season size are important. Selections that have not met these standards have been superseded by selections that have these characteristics. Consequently, by 1992, the most popular clonal lemon selection grown in Arizona was the 'Limoneira 8A Lisbon'. This selection originated in Santa Paula, CA, exhibits high productivity, precocity, earliness, and has adequate fruit quality. Other 'Lisbon' selections still grown in Arizona include 'Prior' and 'Frost Nucellar'. 'Corona Foothills' is a more recent introduction that originates in Corona, CA. This selection purportedly originates from 'Villafranca', has fruit that is indistinguishable from 'Eureka', but has a winter distribution of the crop, similar to 'Lisbon'. "Corona Foothills has a reputation for high productivity and good fruit quality. Therefore, we planted the first 'Lisbon' lemon selection trial in 1993 including 'Limoneira 8A Lisbon', 'Prior Lisbon', 'Frost Nucellar Lisbon', and 'Corona Foothills Lisbon' lemon on

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*C. volkameriana* as the rootstock. Previous results from this trial have been reported in previous issues of the Citrus Research Report

## Materials and Methods

This trial was established in March 1993 in Block 26 of the Yuma Mesa Agricultural Center, near Yuma, Arizona. The land was laser leveled and fumigated prior to planting. Trees were planted on a 10-m x 10-m spacing. Ten replicates of each of the 5 rootstocks were planted for a total of 50 trees. Experimental design is randomized complete block.

Irrigation is border flood, and normal cultural practices are used. For several years, leaves were collected annually in August for mineral analysis; however, there were no significant differences in leaf nutrient content, so that practice has been stopped.

Yield data is typically collected during the fall and winter. For 2007-08, trees were harvested using a ring on 9-27-07 then the trees were stripped of fruit on 11-28-07. For each harvest date, the entire yield was estimated by the number of 65-lb. picking sacks harvested per tree. Then, about 35 lbs. per tree of harvested fruit from each tree per harvest was passed through an automated electronic eye sorter (Autoline, Inc., Reedley, CA), which provides weight, color, exterior quality and size data for each fruit. Fruit packout data is reported on a percentage basis.

All data was analyzed using SPSS 11.0 for Windows (SPSS Inc., Chicago, Illinois).

## Results

Yields for this experiment, since the trees have been bearing, are shown in Figure 1. Counting only the ten years since 1998-99, when yields of these trees first surpassed 100 lbs per tree, 'Limoneira 8A' has ranked first or second in annual yields nine times (each year except 2002-03, when it placed a close third), Corona Foothills has ranked first or second seven times (each year except 2003-04, 2006-07 and 2007-08, the latter 2 being close third), 'Frost Nucellar' has ranked first or second three times (in 2002-03, 2003-04 and 2006-07), and 'Prior' has ranked first or second only twice (2000-01 and 2007-08). Since 1998, 'Limoneira 8A' has averaged 380 lbs. of fruit per tree, while 'Corona Foothills' has averaged 360 lbs. of fruit per tree. At our spacing of 30 x 30 feet, this difference corresponds to 16 field boxes per acre. Meanwhile, 'Prior' and 'Frost Nucellar' have averaged 320 and 314 lbs of fruit per tree, respectively.

Yields for the 2007-08 harvest season are shown in Figure 2. Compared to the previous year (Fig. 1), yields for trees on all the selections tested increased by 500 to 600%. We attribute this increase as a response to the extremely low yields of the 2006-07 year. It is likely that tree carbohydrate levels were depleted after the 2005-06 year and were replenished in 2007-08 so as to support a large fruit load for the 2007-08 season. There were significant differences in yield between the selections tested for the first harvest. 'Corona Foothills' and 'Prior' had the greatest first-harvest yields of 123 and 112 lbs. per tree respectively. These values correspond to 45% of the annual yield of the 'Corona' Foothills' and 38% of the total yield of 'Prior' that was harvested in the first picking. The 104 lb. per tree first-harvest yield for 'Limoneira 8A' and the 83 lb. per tree first harvest yield for 'Frost Nucellar' comprise just 36 and 37% of the total annual yield respectively for these two selections. For the second harvest, there were no significant differences among the selections. Second-harvest yields ranged from 184 lbs per tree for 'Frost Nucellar' to 250 lbs. per tree for 'Limoneira 8A'. Significant differences in annual yield were apparent among the selections. 'Limoneira 8A' had the greatest annual yield of 392 lbs. per tree. This quantity was not significantly different than the 384 lbs. per tree recorded for 'Prior' (98% of the yield of 'Limoneira 8A'), or the 354 lbs. per tree recorded for 'Corona Foothills' (90% of the yield of 'Limoneira 8A'). The annual yield for 'Frost Nucellar' of 295 lbs. (75% of the yield of 'Limoneira 8A') was significantly less than the yields of 'Limoneira 8A' and 'Prior', but not significantly less than the annual yield of 'Corona Foothills'.

Packout for the 9-27-07 harvest is shown in Figure 3. Similar to previous years, 'Corona Foothills' had larger fruit of size 95, and smaller fruit of sizes 140 and 165 compared to the other selections. 'Corona Foothills' and 'Prior' had the largest fruit for the second harvest (Fig. 4). These selections had larger fruit in the size 75 category and smaller fruit in the size 115 and 140 categories as compared to the other selections.

There was no difference in fruit shape, color or exterior quality between the selections for either of the harvests (data not shown).

## Discussion and Conclusions

For the selections, both 'Limoneira 8A' and 'Corona Foothills' still appear to be superior to the other selections tested. Yields for 'Limoneira 8A' were the greatest for the first seven years of this fourteen-year study. Additionally, first harvest yield is generally greater for this selection, compared to the other selections tested. While for 2001-02 and 2002-03, 'Limoneira 8A' did not have the greatest yield, for 2003-04 and 2004/05, it regained the top spot, fell again into second place in 2005-06, but regained the top spot in 2006-07 and 2007-08. Cumulative yield for the 'Limoneira 8A' since planting is about 3830 lbs per tree; the greatest 14-year cumulative yield for all the selections in this trial. Whether 'Limoneira 8A' will remain superior is still not known. Nonetheless, this selection is still the industry standard, and is recommended for planting.

Yield of 'Corona Foothills' has equaled or surpassed 'Limoneira 8A' for four of the past eight years, regaining the top spot in 2005-06 after two years in which it had somewhat lower yield compared to 'Limoneira 8A', but losing the top spot again in 2006-07 and in 2007-08. Fruit size for this selection was typically to be superior to all others, as shown again for this season. For five of the first six years of this trial, this selection was inferior to 'Limoneira 8A', and this early inferiority is reflected in the cumulative yield for 'Corona Foothills' of 3620 lbs per tree; about 6% less than 'Limoneira 8A'. Based on its recent performance, this selection is still recommended for planting.

'Frost Nucellar Lisbon' performed well in 2002-03 and 2003-04; the first two years in which it has done so, but then for the next two seasons it fell back again, then regained second position in 2006-07, but fell again to last in 2007-08. Before 2002-03, this selection has typically had lower, although not always significantly lower, yield than the other selections tested. Cumulative yield for 'Frost Nucellar' since the inception of this experiment is only 3180 lbs. per tree, about 17% less than 'Limoneira 8A'. Fruit size for 'Frost Nucellar' is typically smaller than 'Corona Foothills' or for 'Limoneira 8A'.

After two seasons of superior performance in 2000-01 and in 2001-02, yield of 'Prior Lisbon' was lower from 2002-03, until this year, when it performed well again. This marks a departure from its lower performance typical of 1994 through 2000. Cumulative yield for this selection since the start of the experiment is 3250 lbs. per tree, about 15% less than 'Limoneira 8A'. While fruit size is often good for this selection, the lower yield for most years cannot be discounted.

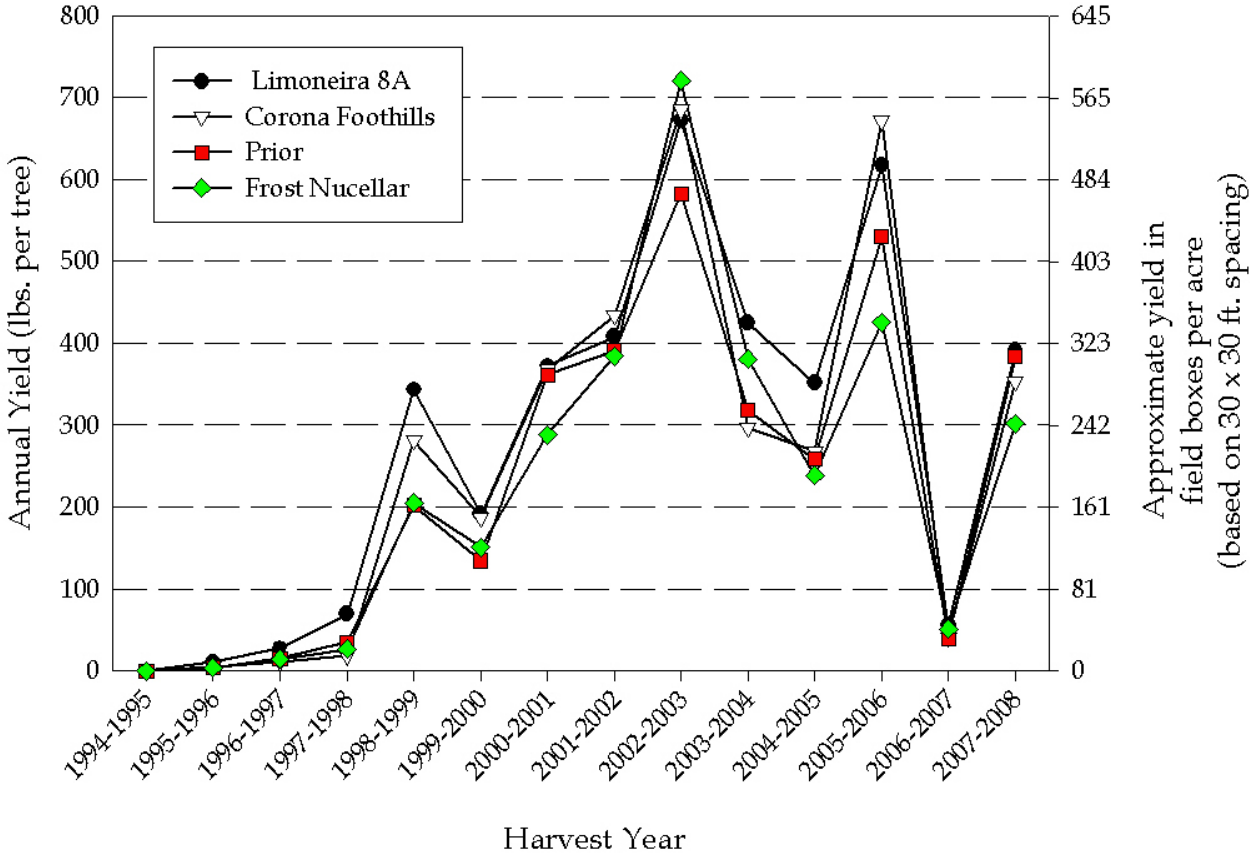


Figure 1. 1994-95 through 2007-08 yields of four lemon selections on *C. volkameriana* rootstock.

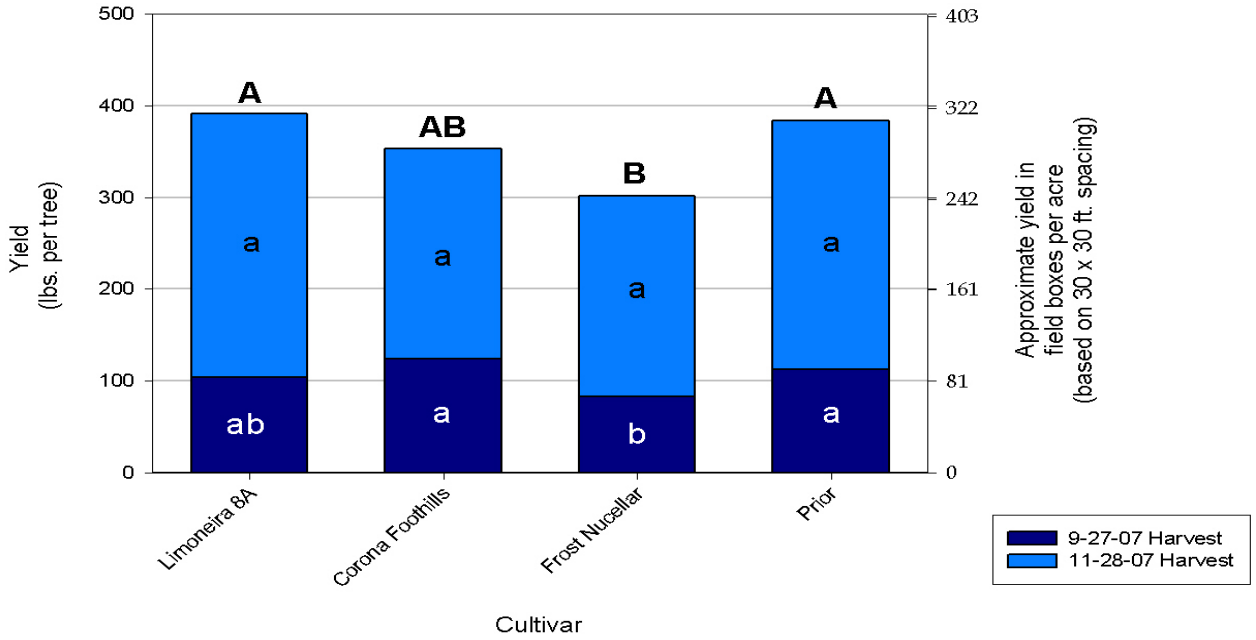


Figure 2. Yields of four lemons on *C. volkameriana* rootstocks for 2007-08. Only letters pertaining to a harvest, or capital letters for the annual yield can be compared statistically. Differing letters designate statistical differences with 95% confidence.

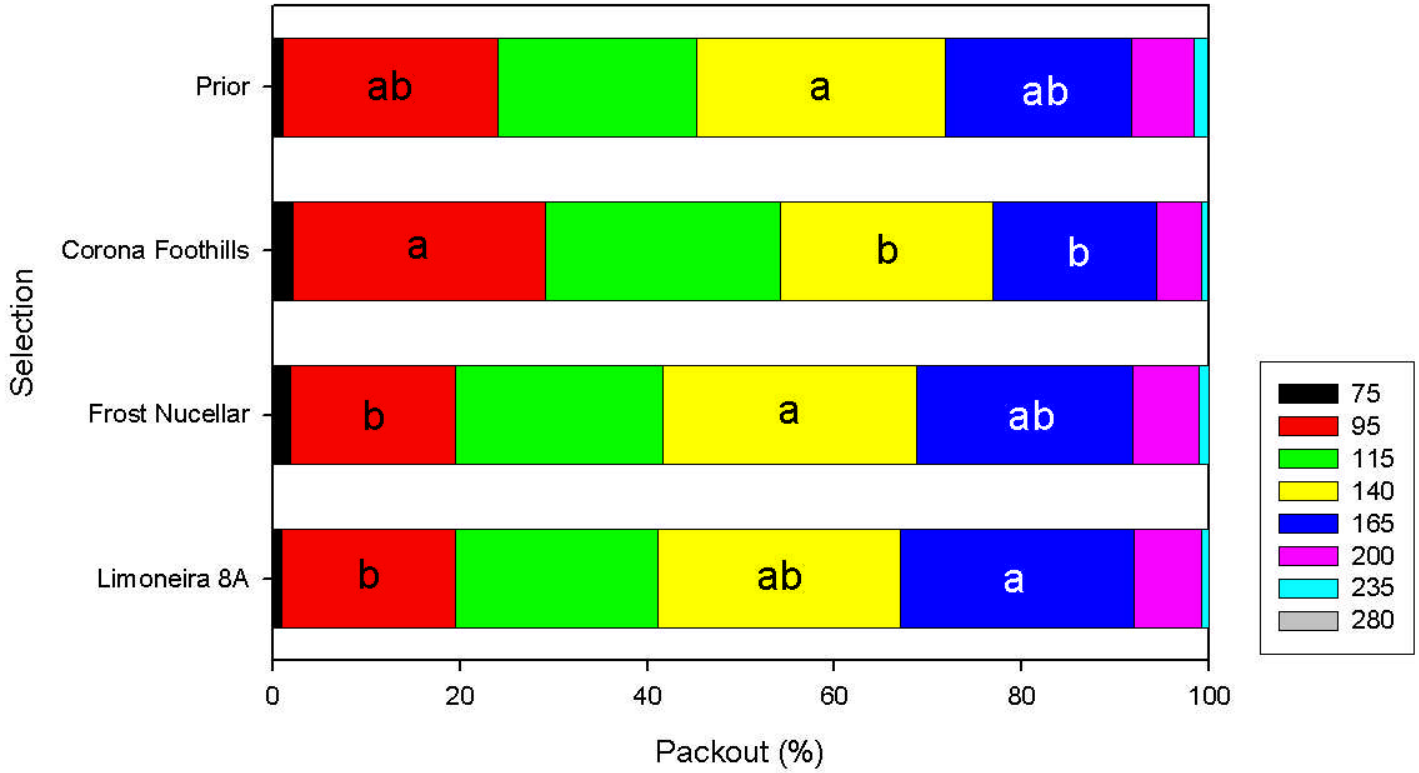


Figure 3. Packout of four lemon selections on *C. volkameriana* rootstock for the 9-27-07 harvest. Only letters within a size class may be statistically compared.

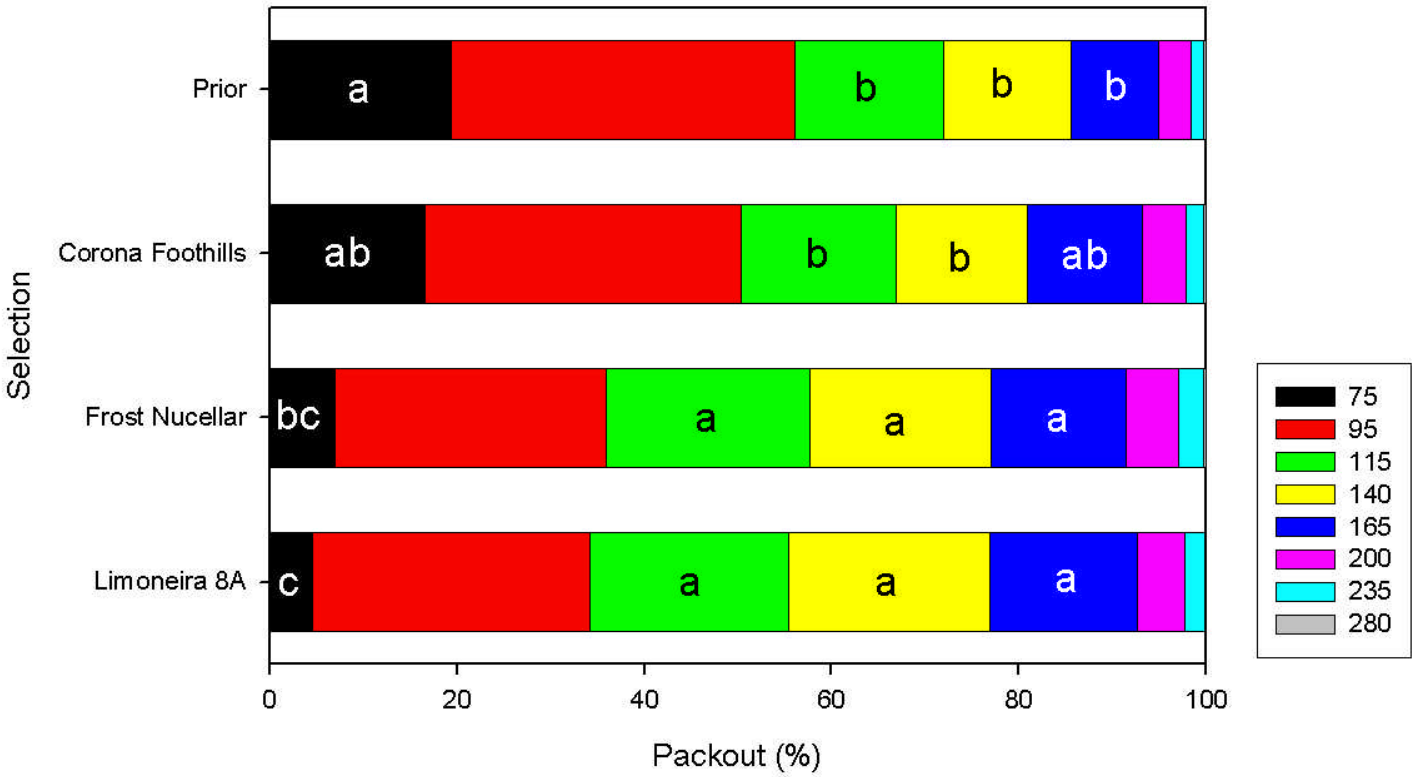


Figure 4. Packout of four lemon selections on *C. volkameriana* rootstock for the 11-27-07 harvest. Only letters within a size class may be statistically compared.